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09/890828
Rec'd PCT/PTO 06 AUG 2001
PCT/US00/32933

HEAT BRIDGES FOR ELECTRIC MOTOR WITH A GEAR CASE

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CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation in part of U.S. Provisional Application No. 60/169,542 filed on December 7, 1999, which is herein incorporated by reference.

TECHNICAL FIELD

The present invention relates to electric motor systems and more particularly to heat transfer methods in electric motor systems.

BACKGROUND ART

In a large number of electric motor applications, it is desirable to minimize heat retained in an electric motor. Maximum temperature rise specifications are prescribed for many applications by government and private regulatory agencies. Agencies such as Underwriters Laboratories specify maximum temperature rise limits for product applications as a requirement for agency listing or recognition of a product. Many consumer product manufacturers will not purchase components or products that are not listed or recognized by specific agencies, particularly Underwriters Laboratories. Therefore, the market viability of many products depends on the product's compliance with Underwriters Laboratory requirements.

It is known that smaller electric motors typically run hotter than larger motors in specific applications. Accordingly, it is known to provide a larger motor or a motor having a higher performance where applications using a smaller motor

or a motor having lower performance fails to comply with heat rise specifications. For example, in the medical equipment industry, it is known that certain small motors have been heretofore unsuitable for use in hospital type beds and assisted chairs because the small motors fail to meet relatively low, for example 100°C, Underwriters Laboratory heat rise requirement. It is known to employ larger or higher performance motors that run cooler in such applications in order to meet the Underwriters Laboratory temperature rise requirement. Such larger or higher performance motors are typically more expensive than smaller or lower performance motors.

It is known to provide heat sink components to radiate excess heat generated by many electronic and mechanical devices. Such heat sink components typically comprise a large surface area that is mounted directly against a surface area of a device to maximize heat transfer from the device to the heat sink. It is common practice in the electronic industry to provide a compliant gap filling substance between heat sink components and the device to which the heat sink is mounted to further promote heat transfer away form the device.

DISCLOSURE OF THE INVENTION

Accordingly, it is a primary advantage of the present invention to provide an improved method of heat transfer in electric motors by employing a thermally conductive gap filler between a motor windings end surface and a mating surface

of a gear case. The method of the invention allows improved heat transfer away from the motor coils and allows a gear case to function as a heat sink.

An additional heat sink which may be mounted to an opposite end of a motor similarly using a thermally conductive gap filler between the heat sink and the motor windings surface provides additional heat transfer away from the motor. Additional heat transfer can be accomplished through the addition of a conductive gap filler. A conductive gap filler "liquid form heat transfer compound" is placed into the gap between the motor and the motor lamination stack.

The heat transfer method of the present invention provides sufficient additional cooling to an electric motor so that a small or low performance inexpensive motor complies with the Underwriters Laboratory heat rise specification for use in hospital type beds and assisted chairs.

It is to be understood that various changes can be made by one skilled in the art in one or more of the several parts of the invention described herein without departing from the scope of the invention.

BRIEF DESCRIPTION OF DRAWINGS

FIG. I is a side section view of a gear case of at least one embodiment of the present invention.

FIG. 2 is a front plan view of a gear case of at least one embodiment of the present invention.

FIG. 3 is a side section view of a motor and gear case of at least one embodiment of the present invention including a heat sink and two thermal pads.

FIG. 4 is a plan view of a thermal pack according to at least one embodiment of the present invention.

FIG. 5 is a side view of a thermal; pad according to at least one embodiment of the present invention.

MODES FOR CARRYING OUT THE INVENTION

Referring to FIG. I that discloses a sectioned side view of a gear case 24 according to the present invention, a gap pad area 20 can be seen within a motor mounting area 22 which is capable of receiving one end of an electric motor where motor windings of the electric motor contact the gear case and a gap pad. Referring to FIG. 2, a front view of the gap pad area 20 and motor mounting area 22 of a gear case according to at least one embodiment of the present invention can be seen.

Referring to FIG. 3 which discloses a sectioned side view of an electric motor 30, two gap pads 26, 32 and a heat sink 34 according to at least one embodiment of the present invention: a first gap pad 26 can be seen installed between the gear case 24 and a first windings end 28 of an electric motor 30. Further displayed in FIG. 3 is a motor gap 40 that is optionally filled with liquid conductive gap filler forming an intimate contact with the motor and the lamination stack further enhancing heat transfer.

A front view of a gap pad 26, 32 according to at least one embodiment of the present invention is show in FIG. 4. A side view of a gap pad 26, 32 according to at least one embodiment of the present invention is shown in FIG. 5. In the

preferred embodiment each gap pad comprises a high performance thermally conductive gap filling material with a thermal conductivity rate at 10 psi of about 3.0 W/m-K., A specific preferred material is supplied by the Bergquist Company and referred to by the trade name Gap Pad ' 3000. The gap pads as used in a preferred embodiment of the present invention have a thickness 36 of about 125 inches.

Mechanical fasteners, typically bolts, secure a motor 30 to a gear case 24 and compress a gap pad 26 in the gap pad area 20 so that a maximum thermal surface is maintained between the motor first windings end surface 28 and the gear case 24.

A heat sink 34 may be secured to a motor second end surface 38 whereby a second gap pad 32 is compressed in a second gap pad area between the heat sink 34 and the motor second windings end surface 38 so that a maximum thermal surface is maintained to facilitate a maximum heat flow between the motor second end and the heat sink 34.

The preferred embodiment of the invention employs a permanent split capacitor motor for application with a gear case to operate hospital type beds and assisted chairs. However the heat transfer method of the invention may be applied to any number of motor designs and applications.

Having thus described my invention, what I claim as new and desire to secure by United States Letters Patent is: